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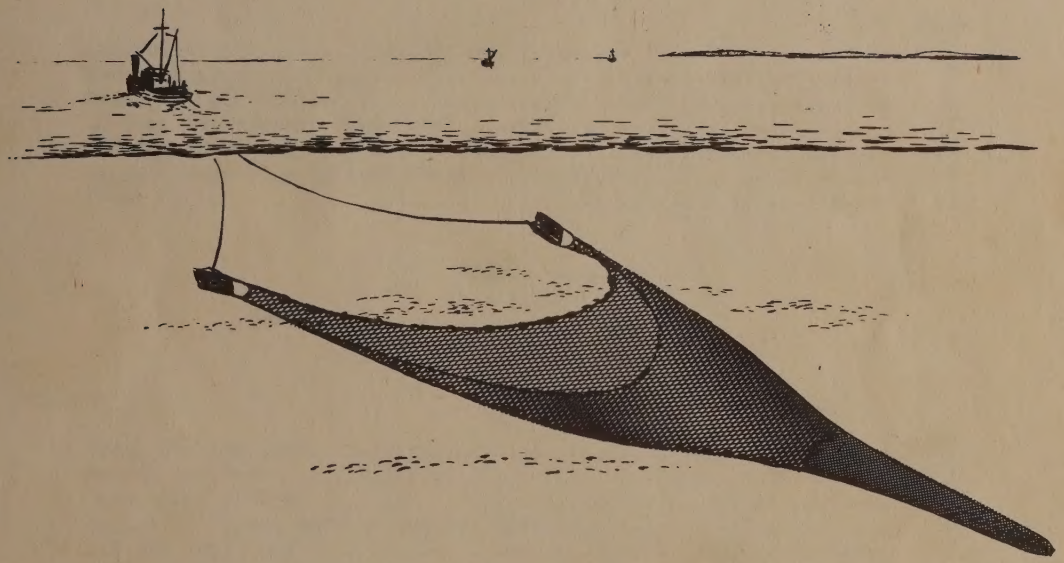
GULF OF MEXICO SHRIMP TRAWL DESIGNS



FISHERY LEAFLET 394

FISH AND WILDLIFE SERVICE

United States Department of the Interior

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Fishery Leaflet 394

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GULF OF MEXICO SHRIMP TRAWL DESIGNS

By Harvey R. Bullis*

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INTRODUCTION

Until recently the shrimp fishery in the Gulf of Mexico has been centered off the northern Gulf Coast and has been conducted mostly by boats permanently based near the grounds. The discovery within the last two years of new fishing grounds off Key West and Mexico, the resultant great influx of Atlantic Coast shrimpers, and the increasing number of larger boats being built locally in the Gulf, has resulted in a migratory shrimp fleet working wherever seasonal changes in the shrimp populations give the best catches.

Prior to this development there was relatively little liaison between fishermen and netmakers from different areas. Each localized fishery used its own favorite gear and no valid comparisons could be made pertaining to various styles of shrimp trawls.

When the Key West grounds were opened in early 1950, boats from the east and Gulf coasts streamed to the new shrimp beds and, for the first time, the popular trawls from the different areas were put on a competitive basis. At the same time, grounds off the Texas and Mexican coasts were worked by migrant boats, and finally, early in 1951, a good-sized fleet appeared on the Mississippi and Alabama coasts to fish the recently discovered offshore shrimp grounds.

As a direct result of these movements of the shrimp fleet, newly introduced styles of trawls are being worked on a large scale for the first time in many areas. The Atlantic coast boats brought the balloon trawl, as it is known locally, into prominence in the Gulf where only flat-type trawls were regularly used before. At Key West they became favored due to a reported cleaner catch, although experimental trawling by the Fish and Wildlife Service Exploratory Fishing Vessel Oregon does not indicate that they produce more shrimp in that area than do flat trawls.

Reports from Biloxi in February 1951 show a sweeping trend toward balloon trawls by the local fishermen in an area that has worked flat trawls almost exclusively in the past. At present the industry is more conscious of the design of gear than ever before, and many changes in usage of different trawl styles may be expected in the next few years.

The purpose of this paper is to give detailed construction information about three principal styles of nets now in use in the Gulf. It must be strongly pointed out that these trawls are not recommended over other designs now in use. They are trawls used successfully by the Oregon in different areas of the Gulf shrimp fishery and are presented to illustrate the basic construction details of similar styles of nets by fishermen and trawl makers.

Terminology

An extensive synonymy of terms exists in the different fishing regions throughout the Gulf. It will be of assistance to define the more important terms used in this paper and list the most commonly used synonyms.

The body or belly refers to the top and bottom tapered part of the trawl, extending from wing to wing and from hanging edge to the point of tail attachment.

The wings are the sides of the net, tapered along the top seam and straight along the bottom seam.

Wingtips are the forward, untapered extensions of the wings.

Jibs, corners, or bats are triangular pieces of webbing attached along the forward edge of the body on either side with an outer edge sewed to a wingtip.

Dog ears are often used in place of jibs and differ from them by having all bars along the hanging edge. Sometimes dog ears and jibs are used on the same trawl (see balloon trawl).

The mouth refers to the forward opening between the cork and lead lines.

The throat or funnel is the narrowest part of the body where it attaches to the tail. There is often an 8-to 30-mesh extension of heavier, smaller-stretch webbing in the throat which greatly reduces gilling of fish and the resulting shark and porpoise bites in this critical area.

The tail, bag, or cod end is an untapered cylinder of heavy webbing which holds the catch while the trawl is fishing.

Various types of chafing gear are used. The most common is unravelled manila strands or hula skirts tied to every other knot on a large-mesh apron under the tail. Sometimes a sheet of canvas is used in the same position.

Shark and porpoise covers of heavier, large-stretch mesh completely encircle the tail. This is to protect the net from sharks and porpoises which bite at the gilled fish, and may be used for attaching the unravelled manila strands.

The cork line, float line, or head line and the lead line, sweep line, chain line, ground line, foot line, or bottom line both extend from door to door. The trawl is hung on these lines, which extend beyond the wingtips and are attached to the trawl doors. These are either manila rope in the case of the smaller nets, or 5/16-inch* manila-clad cable for larger trawls. The floats are either 3-inch corks, 3-to 5-inch rubber floats or 5-inch plastic floats.

Lead line weights are usually 5-per-pound split leads or 1/8-to 1/4-inch galvanized chain in the case of balloon trawls. Spacing of weights varies with different styles of trawls. Flat trawls are customarily tied close to the doors, while balloon trawls usually have from 12 to 20 feet of line between wingtips and doors. Rope lines are tied directly to the doors. Thimbles are spliced or clamped on manila-clad cable lines, and the trawl is shackled to the doors.

A series of 2-inch galvanized iron rings are tied around the front and around the end of the tail. The forward series is set back 13 meshes and holds the 1-inch manila lazy line. The lazy line is used to haul the tail on

*ALL LINE SIZES USED HEREIN ARE GIVEN AS DIAMETER MEASURE.

deck. It encircles the tail in a loose loop, tied with a bowline, runs forward with a few fathoms slack, and is tied to one of the doors. The rear series is set 15 meshes forward of the end of the tail and holds the 1/2-inch manila trip line or tie line. The trip line is tied with a series of 3 or 4 chained slip knots.

Most shrimp trawls are cut and hung so that the lead line rides behind the float line. This is referred to as overhang, setback, undercut, or cutback. This may be accomplished either by cutting into the bottom of the body as in the balloon trawl, by setting the entire bottom of the net back as in the 100-foot flat trawl, or by spacing the float-line hanging closer than the lead-line hanging. Some trawls with a deep cutback use a tickler chain of adequate length between the doors to drag behind the float line and scare the shrimp off the bottom in advance of the lead line.

The trawling cable or warp varies between 1/4-and 1/2-inch steel cable for almost all boats shrimping in the Gulf, depending on their size. The common cable length-depth ratio is 5 or 6 fathoms of line to 1 fathom of water to assure full spread of the trawl, although occasionally in deeper water the Oregon successfully employs a 3 to 1 ratio.

Trawl doors or otter boards vary in size with the trawl. Doors 5 to 14 feet long are employed in the Gulf fishery.

Handling Fish Netting

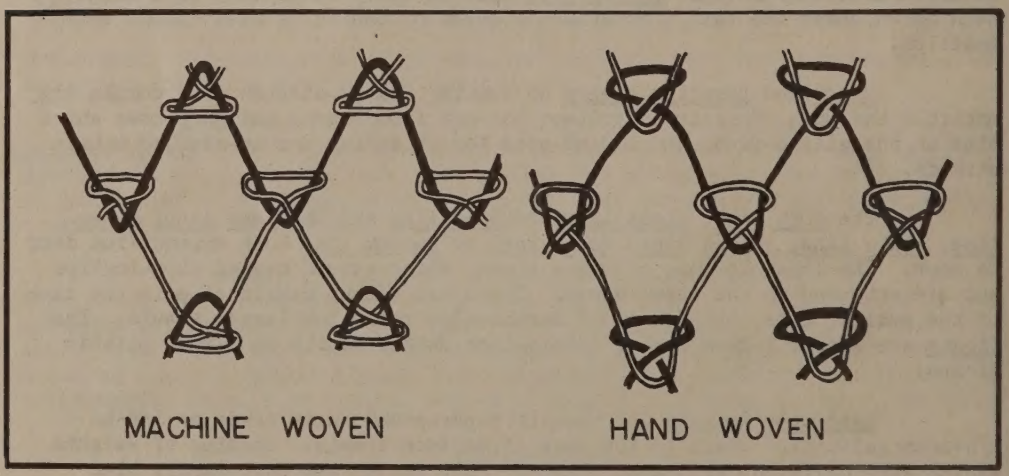


FIGURE 1. TRAWL WEBBING KNOTS.

Fish netting or webbing is a sequence of loops or half meshes which are interwoven by knots to form a series of meshes. A single mesh is the combined upper and lower half meshes tied midway by a hitch. Machine-made netting is woven parallel to the double selvage, lengthwise or from end to end, while hand-made netting is woven down from the double selvage, or from top to bottom. There is a slight difference in the position of the knots in the two processes, as seen in Figure 1, but this does not affect the strength or stretch direction of either weave.

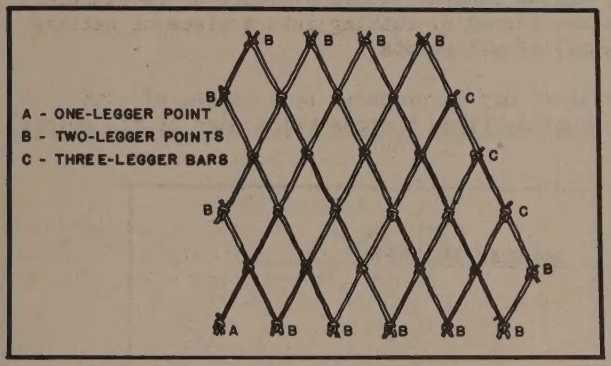


FIGURE 2. POINTS AND BARS.

Netting generally is designated by the size of the mesh in a stretched form and is measured by the number of meshes in length and depth. The length is often expressed in feet or fathoms when a large quantity is ordered. 1/

The knots along the edges of netting are called points and bars. (Figure 2). A point is a knot with one or two legs. A bar is a knot with three legs.

Netting can be stretched in two directions, straight twine and cross twine as shown in Figure 3. Straight twine pulls at right angles to the double selvage, tightening the knots, and offers the maximum strength. When cutting sections of netting it is important to remember this and have the direction of greatest strain running parallel to the straight twine. A cross-twine strain loosens the knots and pulls the meshes out of shape.

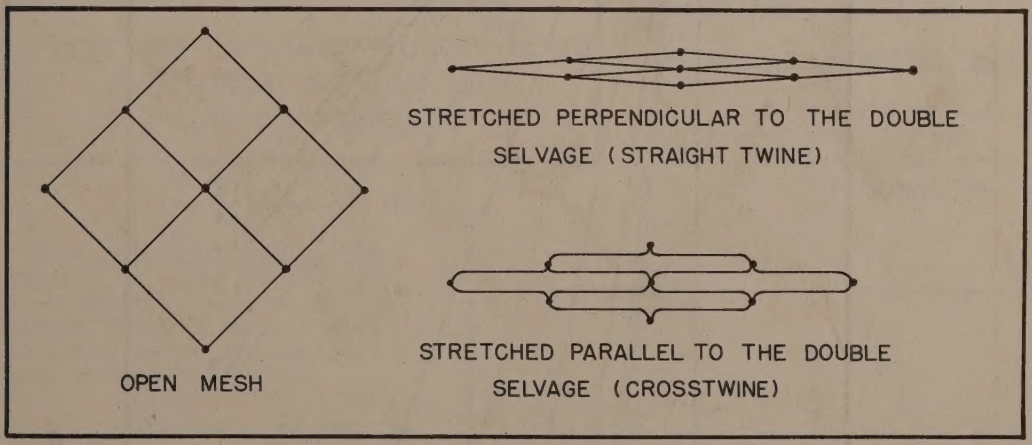

STRETCHED PERPENDICULAR TO THE DOUBLE SELVAGE (STRAIGHT TWINE)
STRETCHED PARALLEL TO THE DOUBLE SELVAGE (CROSSTWINE)
OPEN MESH

FIGURE 3. STRETCHING WEBBING.

Double selvage can be tied along any edge of netting to reinforce it; however, usage of the term by the Gulf industry always implies a cross-twine edge so that when the webbing is pulled at right angles to it the stretch is running straight twine.

1/ KNAKE, BORIS O., METHODS OF NET MENDING - NEW ENGLAND, PART 1: U.S.F.W.S., FISHERY LEAFLET 241, MAY 1947, WASHINGTON.

"Squaring" a corner is cutting an angle of 90°. A "square" piece of webbing does not necessarily imply that all four sides are of equal length, but that all four corners are right angles forming either a square or rectangular piece of webbing. Right angles are formed by cutting into a piece of netting on all points from a selvage (edge) of all points.

Different angles of "taper" may be produced by a series of cuts (Figure 4). They are formed by cutting (from a cross twine edge of all points)

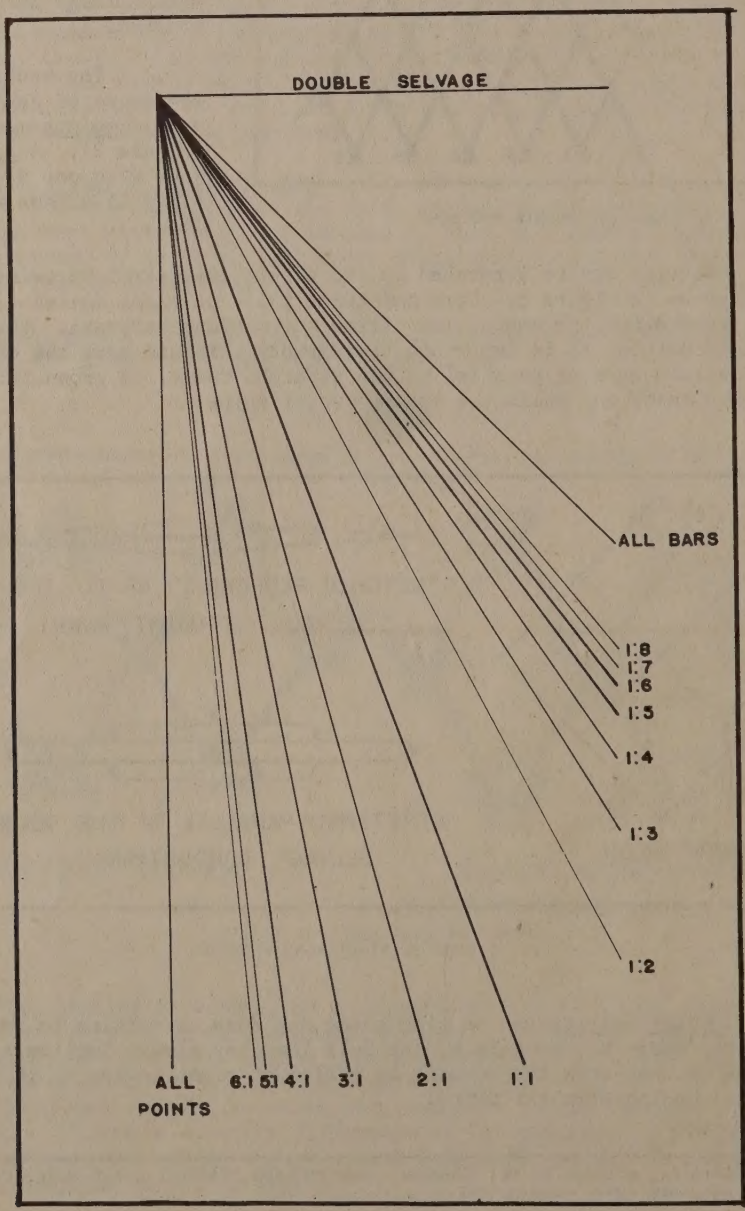


FIGURE 4. ANGLES OF TAPERS MADE BY SEVERAL BODY CUTS.

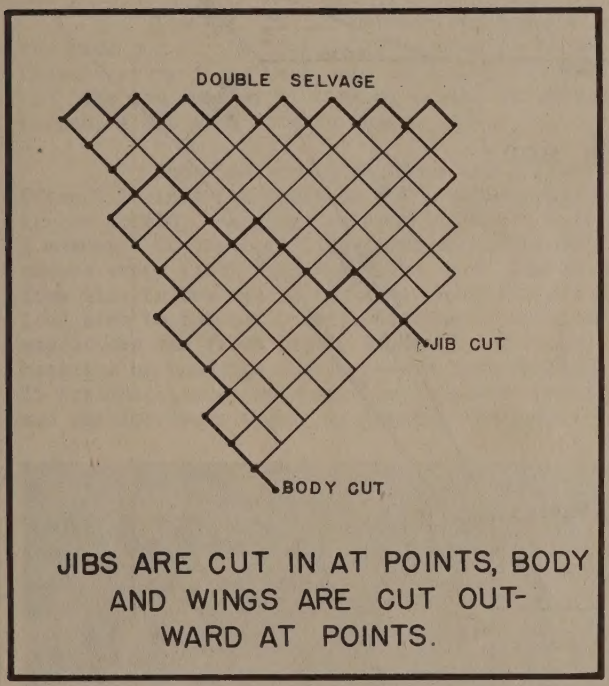


FIGURE 5. JIB AND BODY CUTS.

used a 40-foot no-overhang flat trawl as an exploratory try-net with very good results. It has fished well from shallow water to depths of 500 fathoms when used with weighted doors.

This net is of the simplest design now in use (see Figure 7). The top and bottom are 210 meshes wide, cut on a 1 point - 2 bar taper. There is no setback to the bottom. The wingtips are cut square, 60 meshes long and 42 meshes deep. The wings are tapered on the top with 4 point - 2 bar cut. The bottom of the wing is straight points. The jibs are all the same, all points along the cork a series of 1 point - 2 bars, 1 point - 4 bars, or 2 points - 1 bar, etc., cuts along the edge to be tapered. These cuts may be made two different ways and it is easy for the beginner to make a serious error here. Figure 5 shows the diverging cuts of the same point and bar count. Body and wing tapers are formed by cutting points out or away from the piece of netting being shaped. Jib tapers are formed by cutting into the piece at the points.

All seams are sewn with a four-corner-mesh stitch. The 1 point - 1, - 2, - 4 and - 6 bar tapers are most commonly used because of the facility with which such seams may be sewn together or to a straight edge. Figure 6 demonstrates the direction of sewing a tapered edge to a straight edge. All stitches produce four-cornered meshes.

40-Foot No-Overhang Flat Trawl

This style has had its greatest usage off the Alabama, Mississippi and Louisiana coast. The Oregon has

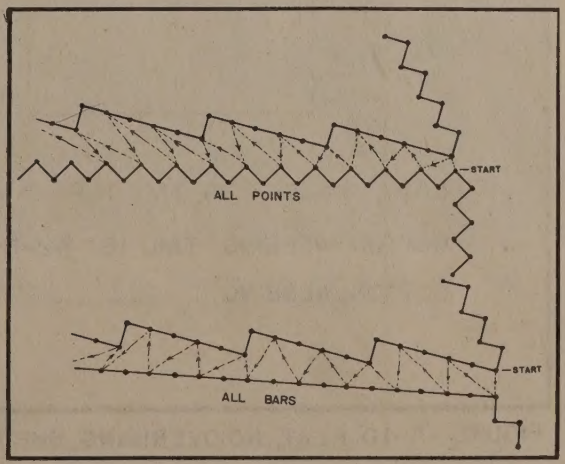
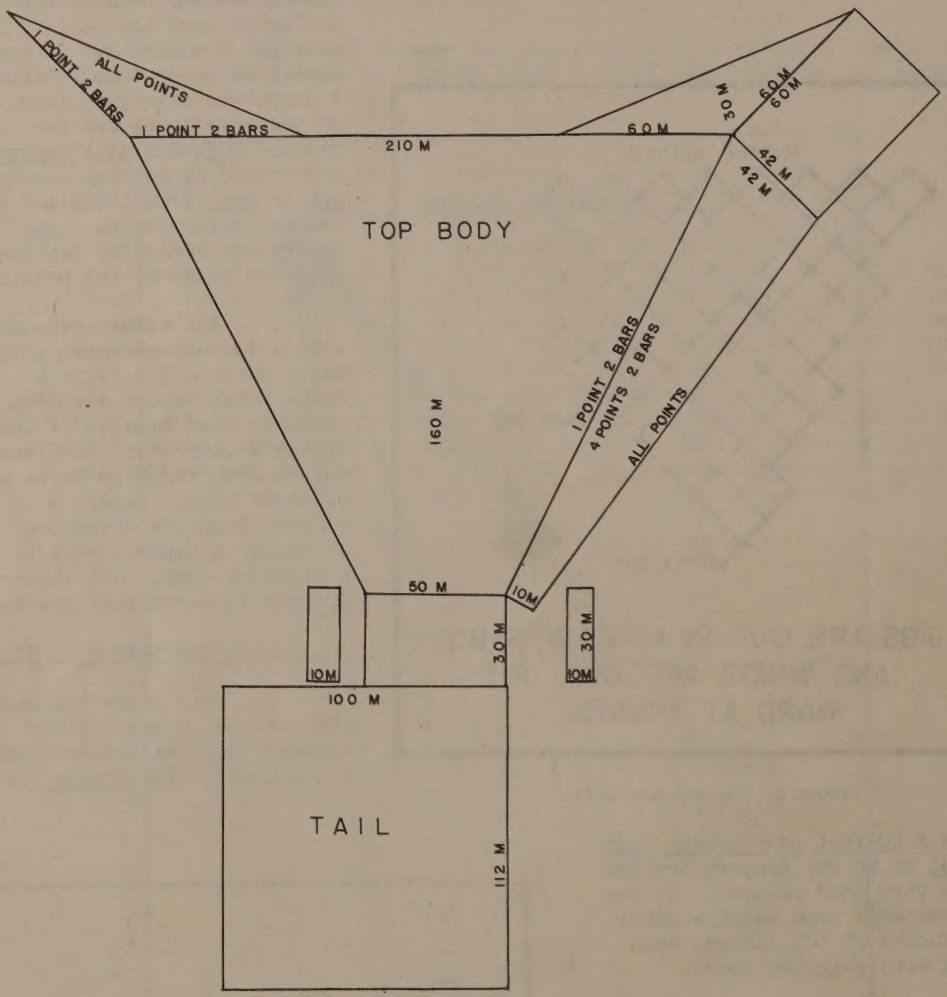


FIGURE 6. SEWING A TAPERED SEAM



BODY, WINGS, JIBS, AND THROAT ARE 15-THREAD, 2" STRETCH COTTON WEBBING. TAIL IS 42-THREAD, 1¾" STRETCH COTTON WEBBING.

FIGURE 7. 40' FLAT, NO OVERHANG SHRIMP TRAWL USED ON M/V OREGON

and lead lines with 60 meshes cut on a 1 point - 2 bar taper along the jib-body and jib-wingtip.

Many fishermen prefer to add an extra 8 to 30 meshes of smaller, heavier webbing in the throat, square with the ends of the body and wings. This extension strengthens and lengthens the throat and reduces gilling in this area.

The tail is 112 meshes long and 100 meshes in circumference. Since the back end of the body is 120 meshes in circumference, it is necessary to "catch" every fifth mesh when attaching the tail to the body. The body, wings, and jibs are made of 15-thread, 2-inch stretch mesh. The tail is made of 42-thread, 1 3/4-inch stretch mesh.

Both lead and cork lines are 1/2-inch or 5/16-inch manila rope. Often 7/16-inch net cable or 6 X 4 manila-clad cable are used, especially for larger models. Hangings on both lines are made every 4 1/2-inches, catching 3 meshes. On the cork line catch an additional mesh every fifth hanging (4 meshes every fifth hanging). The cork line is hung approximately 4 inches from line to the double selvage. Hangings are approximately 6 inches from lead line to the net. Three-inch corks are spaced every tenth hanging all the way across the float line. Leads (5 per pound) are spaced one every three hangings on the jibs and one every five hangings on the body. For depths over 15 fathoms, leads are spaced and attached one for each hanging on the jibs and one for every three hangings on the body.

FIGURE 8. A 12-FOOT MODEL OF THE NO-OVERHANG FLAT TRAWL. THE TOP AND BOTTOM BODY AND JIBS ARE IDENTICAL. (COURTESY OF THE MARINOVICH TRAWL COMPANY, BILOXI, MISSISSIPPI.

Lazy-line rings are attached 13 meshes back on the tail. Every 13 meshes, 5 meshes are caught and tied individually to a ring. The trip-line rings are attached 15 meshes forward of the end of the tail. Every 5 meshes 5 meshes are caught and tied individually to a ring. For the lazy line 18 fathoms of 1-inch diameter manila rope is used. One-half inch diameter manila rope is used for the trip line. It is tied with 3 or 4 chained slipknots.

Spliced or clamped eyes on the float and lead lines are optional. Usually the lines are just tied to the doors if they are rope, or attached with shackles if manila-clad cable is used.

This net is used with 5-foot trawl doors. The cork line is tied snug to the door while the lead line has 8 to 10 inches of slack between net and doors.

100-Foot Overhang Flat Trawl

This style has been used widely along the Texas and Louisiana coasts and is often referred to as the "Texas" rig. It differs from the 40-foot flat type in that the bottom of the body and the bottom wings have been set back (or undercut) 36 meshes. (See Figure 9). Two pieces of 18-thread, 2-1/2 inch stretch webbing are cut on a 1 point - 4 bar taper from a 420 mesh front down to 100 meshes at the throat. An 80 mesh extension, 100 meshes wide is added to the throat end of the top body. Since the bottom piece is set back 36 meshes, an additional square piece of webbing 44 meshes by 100 meshes is added to the throat end of the bottom and a square piece 80 meshes by 20 meshes is added to the end of each wing. This makes the throat 240 meshes in circumference.

All 4 jibs are the same. They are cut on 1 point - 2 bars (120 meshes on the jib-body and jib-wingtips seams) with all points on the hanging side. The bottom jibs are set back the 36 meshes with the body and a strip 10 meshes wide and 36 meshes long is added to the forward tips. This strip is even with the forward ends of the wingtips making the trawl 85 meshes "deep" on the sides.

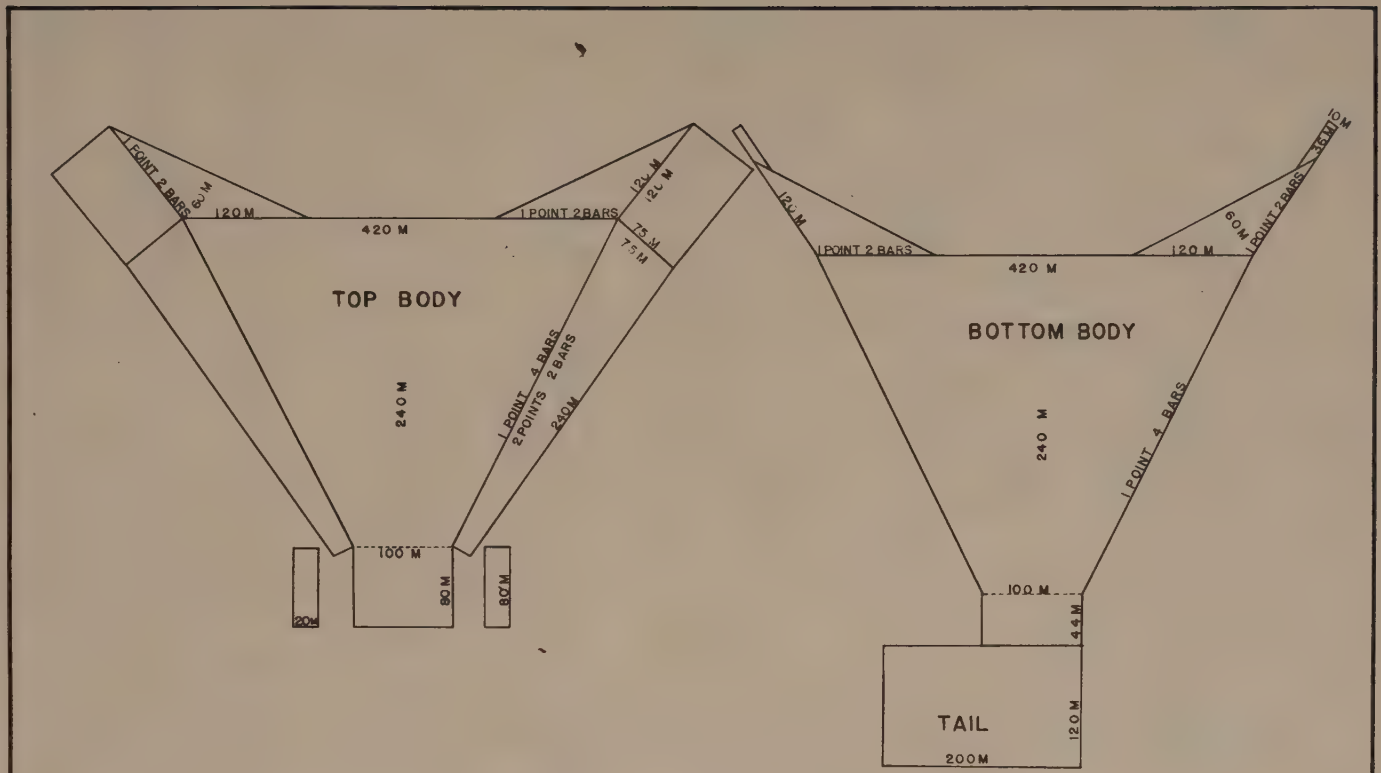
The wingtips are cut square, 75 meshes by 120 meshes with the wings tapering on a 2 point - 2 bar cut along the top and 240 meshes on points along the bottom exclusive of the 20 mesh by 80 mesh additions.

The tail is 42-thread, 2 1/2-inch stretch mesh (often 2 or 2 1/4-inch), 120 meshes long and 200 meshes in circumference. It is attached to the throat catching every fifth mesh on the throat.

The cork and lead lines are 7/16-inch, 6 x 6 manila-clad net rope. Both lines are hung the same, every 5 1/2 inches catch 3 meshes. Four-inch corks are spaced every 20 hangings across the body section of the corkline. The leads are 5-per-pound, 2 leads for each hanging on jibs and 1 lead for every other hanging on the body.

The lazy line is 30 fathoms of one-inch manila rope. The lazy-line rings are attached 13 meshes behind the front of the tail, one ring every 13 meshes catching 5 meshes. The trip-line rings are 15 meshes forward from the end of the tail, a ring every 5 meshes catching 5 meshes.

Twelve-foot doors are used with no slack between doors and wing tips.



BODY, WINGS, JIBS, AND THROAT ARE 18-THREAD, 2½" STRETCH, COTTON WEBBING.

TAIL IS 42-THREAD, 2½" STRETCH, COTTON WEBBING.

FIGURE 9. 100' FLAT, 36-MESH-OVERHANG SHRIMP TRAWL USED ON M/V OREGON

74-Foot Four-Seam Balloon Trawl

The style commonly used in the East Gulf fishery is the balloon trawl, a term which actually refers to several different nets which are constructed to ride partly off the bottom. Since the term balloon trawl applies to a particular style of shrimp net now being used in the Gulf, it will be best to designate it as such. There are several different modifications of this type resulting from individual preferences for a longer or shorter body. The first balloon trawl used by the Oregon was made by a Florida trawl maker catering to the local fleet. This style and modifications of it have been tested in two sizes. A 74-foot model has proved satisfactory in Florida waters. A 40-foot trawl built on these lines has been found consistently to "choke-off" at the throat so the catch builds up in the body of the net.

The balloon differs from the flat-type shrimp trawls in having dog-ears, wings that do not extend to the throat, different hanging, and a much wider throat. (See Figure 10).

Both top and bottom hanging edges are divided into three equal sections. Each dog-ear is the same length along the hanging edge as on the body. On the bottom the smaller dog-ear is supplemented by the undercut to keep the same ratio as on top. Some trawl-makers prefer the hanging edge on the body to be twice that on each of the dog-ears.

All webbing, except for the tail, is 18-thread 2 1/2-inch stretch mesh. The top and bottom body are the same width and are cut on a 1 point - 6 bar taper. This is a very sharp taper, and many fishermen prefer a 1 point - 4 bar cut. The front of the body is 480 meshes wide, its length extending back 213 meshes to a width of 160 meshes at the throat making the throat 320 meshes in circumference. The bottom is undercut 60 meshes, 100 meshes in from each side on all bars. The new front is cut parallel with the front of the net on all points (160 meshes wide).

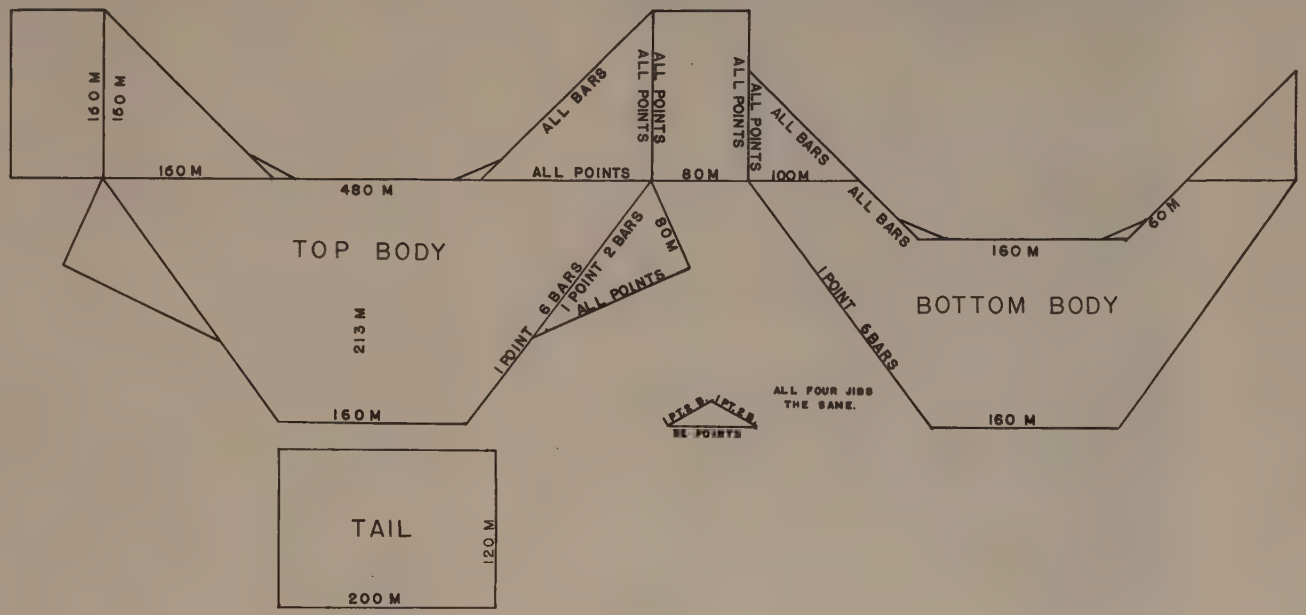
The wingtips are cut square, 160 meshes long and 80 meshes wide. The wings are 80 meshes deep along the wingtip-wing seam with a 1 point - 2 bar taper along the top body seam, all points along the bottom body seam. Cut in this manner the wings will extend back 160 meshes along the body.

The dog-ears have 160 meshes (all bars) along the hanging edge and 160 meshes (all points) along wingtip and body seams. Points pulling cross mesh are tied to wingtips. Points pulling with the mesh are tied to the body. Bottom dog-ears have 100 meshes (all points) along the wingtip and body seam. Thus the hanging edges of the bottom dog-ears are continuous with the undercut taper in the bottom.

At the obtuse angles formed by the top dog-ears and hanging edge of the body small jibs are tied. They are 8 meshes deep, 32 points on the hanging edge and are cut on a 1 point - 2 bar taper. Jibs of the same dimensions are tied in the corners of the undercut in the bottom.

The net is usually used with 8-foot doors although 12-foot doors have been used successfully. The float and lead lines extend about 20 feet beyond the wingtips and are shackled to the doors.

The tail is 42-thread, 2 1/2-inch stretch mesh, 200 meshes in circumference and 120 meshes long. In joining the tail to the throat, 8 meshes must be caught on the throat for every 5 on the tail (in each 5 meshes on the tail,



BODY, WINGS, DOGEARS, AND JIBS ARE 18-THREAD, 2 ½" STRETCH COTTON WEBBING.

TAIL IS 42-THREAD, 2 ½" STRETCH COTTON WEBBING.

FIGURE 10. 74' BALLOON TRAWL USED ON M/V OREGON

the first and last catch one mesh on the throat while the 2nd, 3rd, and 4th catch two meshes). Thirteen meshes back from the forward end of the tail, two-inch galvanized lazy-line rings are tied 13 meshes apart catching 5 meshes. The lazy line is 21 fathoms of 1-inch manila rope. Two-inch trip-line rings are attached 15 meshes forward of the end of the tail, 5 meshes apart, catching 5 meshes.

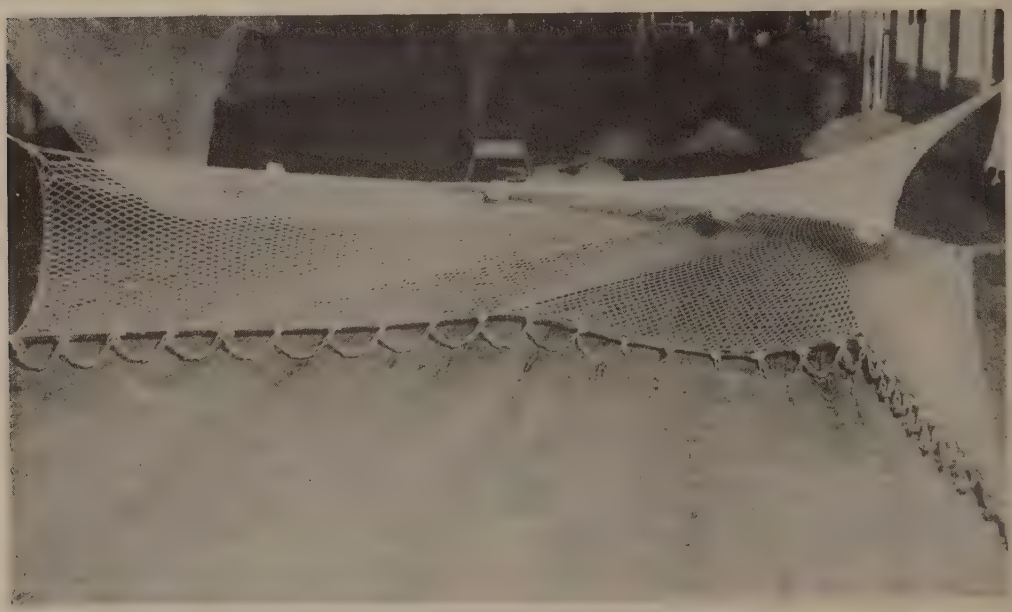


FIGURE 11. A 12-FOOT MODEL OF THE 4-SEAM BALLOON TRAWL. THE LENGTH OF THE HANGING EDGE ON THE BODY IS TWICE THAT ON EACH DOG-EAR IN THIS PARTICULAR STYLE. (COURTESY OF THE MARINOVICH TRAWL COMPANY, BILOXI, MISSISSIPPI).

The trawl is hung on 7/16-inch net rope. All bars (the dog-ears) are hung stretched and tight to the line. Recently the Oregon has used this net with the dog-ears hung 3 inches off the line, catching 3 meshes for each 5 1/2-inch hanging. The rest of the cork line is hung every 5 inches, catching 3 meshes, about 4 inches off the line (line to double selvage). Seven 5-inch plastic floats are attached along the cork line, one in the middle and at 4, 10, and 22 hangings from center on both sides. One-eighth to 1/4-inch galvanized iron chain is hung at one-foot intervals with about 2 inches of slack chain for each hanging from wingtip to wingtip along the lead line.

Trawl Doors

Trawl doors or otter boards used on shrimp nets are considerably lighter than those used on the North Atlantic fish trawls. In general usage, doors of 4 to 5 feet in length are used on trawls up to 50 feet in width, 6-to 8-foot doors on trawls up to 80 feet, and 9-to 14-foot doors on nets up to 120 feet wide. The Oregon has used 5, 8 and 12-foot doors in shrimping operations with nets that fall in the above ranges.

Usually trawl doors can be purchased completely rigged. The length of the door bridle chains varies according to wishes of individual fishermen. When doors are purchased the chains are cut with a few extra links and can be set according to individual preferences. The 1 to 2 ratio is generally used. That is, the top forward strand is set one link longer than the bottom forward strand, and the top rear strand is set two links longer than the bottom rear strand. The forward chains are approximately 1/2 to 2/3 the length of the rear chains. Set thus, the doors have an outward, downward thrust while being towed through the water. Door chains are either 1/4-or 5/16-inch galvanized iron chain. On the larger doors the chains are connected to a 1/2-inch swivel by a 1/2-inch shackle. One-fourth-inch shackles and swivels are used on doors up to 6 feet. The swivels are attached to the trawling cables by shackles of the same size.

All doors are equipped with iron runners or shoes curved upward at the leading edge. Supporting structures such as upright iron bands, welded to the runner and bolted to the door, are used on doors over six feet in length. The need of expensive equipment for building trawl doors usually prohibits the fisherman from building his own. Figure 12 shows the essential construction details of a 12-foot door used on the Oregon. Materials needed to build a pair of these doors are as follows:

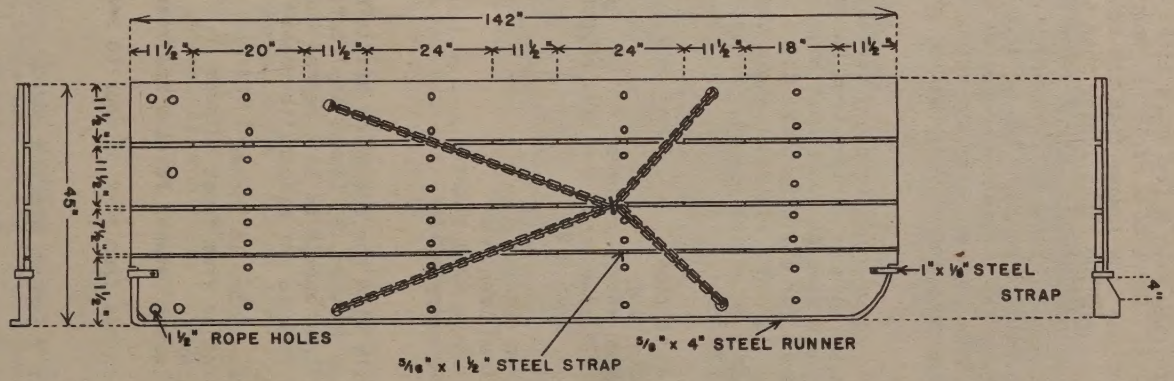
110 feet of 1" x 12" white pine
24 feet of 1" x 8" white pine
26 feet of 5/8" x 4" iron strap (runners)
28 feet of 5/16" x 1 1/2" iron strap (upright supports)
64 steel nuts and bolts, 1/2" x 2"
64 steel washers, 1/2"
2 feet of 1/8" x 1" iron strap
4 feet of 1/2" galvanized iron rod
20 feet of 5/16" galvanized iron chain
2 pounds galvanized ten-penny nails
8 reinforcing rings, 1"

The doors work satisfactorily with the following bridle strand lengths; top forward, 34 links; bottom forward, 33 links; top rear, 73 links; bottom rear, 71 links. A few extra links should be left beyond the attachment pin to permit adjustments. Standard formula for spacing the chain is:

L = total length of trawl door in inches
$\frac{L}{4} - 1$ = distance in inches from front of door to front chains
$\frac{L}{4} \times 2$ = distance in inches between forward and rear chains
$\frac{L}{4} + 1$ = distance in inches from rear of door to rear chains

Both top and bottom chains are set-in 2 inches from the edge.

When used in deep water the doors are weighted with iron bars bolted 6 inches above the runner. In this manner 5-foot trawl doors, each weighted with a 100-pound bar, have fished successfully in over 450 fathoms with a cable-depth ratio of 2 to 1.



BOARDS ARE ¼" DRESSED NO. 1 PINE.
BRIDLE CHAINS ARE ⅝", GALVANIZED:
TOP FORWARD - 34 LINKS
TOP REAR - 73 LINKS
BOTTOM FORWARD - 33 LINKS
BOTTOM REAR - 71 LINKS

FIGURE 12. 12' TRAWL DOOR USED ON M/V OREGON.

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